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the theory that the South Atlantic bridge was present even in the Miocene.

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[1] Gagel, C., *Handbuch der Regionalen Geologie*, 7, Pt. 10, Heidelberg, 1910.

[2] Barrell, J., *Amer. J. Sci., New Haven, Conn.*, (Ser. 4), **40**, 1915, (1–22). Also see Wright, W. B., *The Quaternary Ice Age*, London, 1914, chaps. 16 and 18; and Goldthwait, J. W., *Amer. J. Sci., New Haven, Conn.*, (Ser. 4), **32**, 1911, (291–317).

[3] Perret. F. A., *Amer. J. Sci., New Haven, Conn.*, (Ser. 4), **42**, 1916, (443–463).

THE RESPONSES OF HYDROIDS TO GRAVITY

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Read before the Academy, November 14, 1916

Corymorpha palma is a solitary hydroid occurring on the mud-flats of False Bay and other like localities in the neighborhood of La Jolla, southern California. It has a length of body that may exceed even 6 or 7 cm. In its natural position under water its basal end is imbedded in the mud, above which its stem rises vertically, carrying at the opposite end the somewhat drooping head. When Corymorpha is removed from the mud and allowed to attach itself to some foreign base which can be conveniently turned in an aquarium, it assumes in a very short time a vertical attitude irrespective of the position of the base. This vertical attitude is acquired and maintained by the stem even after the head has been cut off and this part may therefore be said to exhibit negative geotropism. The stem is provided with a neuromuscular sheath and a core of vacuolated cells like those in the chorda of vertebrates. Torrey has raised the question of the relative importance of the neuromuscular sheath and of the core cells in bringing about the geotropic response and has advanced evidence in favor of the view that the core cells, acting as certain vegetable tissues often do, are the mechanism of this response. If, however, Corymorpha is placed in sea-water containing some chloretone, by which the neuromuscular activity is abolished but the core cells are left unchanged, no geotropic response can be obtained when the animal is moved out of the vertical. When the core cells are disorganized by twirling a needle in the axis of the stem, care being taken that the neuromuscular sheath is not injured, the stem will show a tardy but successful geotropism. It therefore seems probable that the geotropic response in Corymorpha, as in most other animals, is the result of the activity of the neuromuscular sheath and not of the core cells, though the latter very probably help to maintain the geotropic position by assuming a somewhat fixed arrangement favorable to the particular curve or form of the stem imposed by the neuromuscular response. The work thus briefly reported upon was carried out last summer at the Scripps Institution for Biological Research, to the staff of which the writer is indebted for many courtesies.

[1] Contributions from the Zoological Laboratory of the Museum of Comparative Zoology at Harvard College, No. 287.

THE LIPS AND THE NASAL APERTURES IN THE GNATHOSTOME FISHES, AND THEIR HOMOLOGUES IN THE HIGHER VERTEBRATES

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Two distinctly different types of upper and lower lips, and a third type of upper lip are found in the gnathostome fishes, and they may be called the primary, secondary and tertiary lips.

The primary lips lie immediately external to the dental arcades developed in relation to the palatoquadrates and mandibulae, and they must, because of this position, have primarily lain but slightly, if at all, anterior to the oral plate of embryos. The primary cavity of the mouth lies internal to these lips. The hypophysial invaginations probably lay external to them, as they actually do lie external to the upper and primary lip of Petromyzon, and to both the primary and secondary upper lips of Amia and Acipenser.

The secondary lips of either side lie external to the primary ones, and have been developed from what was primarily simply a fold of the external dermis that lay posterior to the angle of the gape of the primary lips. The pressure of the musculus adductor mandibulae, where it passed around the angle of the primary gape, caused this fold to bulge forward across that angle, and its anterior surface was then presented antero-mesially. The crest of this fold then formed a secondary angle of the gape, which lay antero-lateral to the primary angle, and short secondary lips ran forward from it, in either jaw, to join the primary lips. These primarily short secondary lips then gradually extended forward in either jaw and ultimately there reached the median line and coalesced with their fellows of the opposite side, a band of the external surface of the head, lying between these secondary lips and the primary ones, thus being enclosed in the cavity of the mouth as a secondary